DRILLING DATA FROM EXPLORATION WELL 2-2A, NW1/4, SEC. 15, T. 5 N., R. 31 E., IDAHO NATIONAL ENGINEERING LABORATORY, BUTTE COUNTY, IDAHO

TEMPERATURE

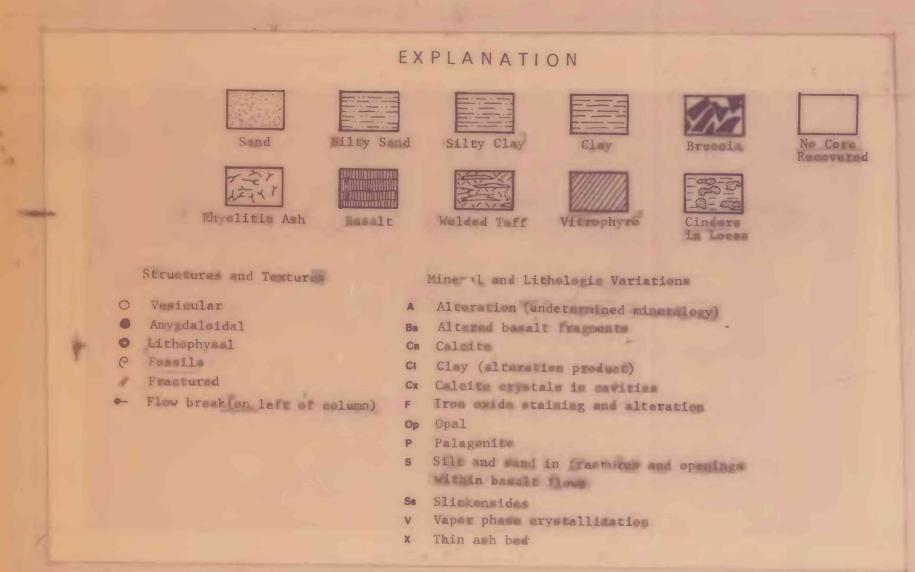
58 66 74 82 90 98 106 114

LOGS

50 60 70 80

David J. Doherty

SCALE



DISCUSSION

The U.S. Department of Energy, in cooperation with the U.S. enlogical survey, drilled three exploration wells on the eastern Snake Fiver Flain, Idaho, during the summer and fall of 1978. The wells were notinuously cored, and range in depth from 2,000 ft (610 m) to 3,000 ft (914 m). The wells were drilled to obtain subsurface geologic intermetion pertaining to geothermal exploration in three areas of the eastern basks River Plain which have distinctly different types of

Two of the wells are located on property of the Idaho Mational Engineering Laboratory (INEL), Idaho with the third well being located in Sugar City, Idaho (Embree and others, 1978).

his preliminary report describes the lithology, and shows the ammerature distribution, and geophysical logs of well 2-2A, located on On find sice in the NW 1/4, sec. 15, T. 5 M., R. 31 E., Butte County, daho. The well was located by the U.S. Geological Survey to obtain authorizace (aformation on 1) the character and distribution of basaltic land flows and interbedded sediments, 2) the age of the rocks and sediments, 3) the nature and extent of alteration of the rocks, and on extinate of the heat flow in the area.

orilling on well \$2 began June 13, 1978. At a depth of 412 ft difficulties were encountered in drilling. A new well drilled approximately 20 ft (6 m) east of the original well site, teaching a total depth of 3,000 ft (914 m) on September 23, 1978. The logs presented here are a composite of both wells (2 and 2A).

The goodney of the area near the well has been briefly described by Antertson, Schoen, and Barraclough (1974), Nace and others (1975); and Halds and others, (1971); the subsurface seclosy is generalized by walker (1964). K-Ar dates of some of the volcanic rocks on the Idaho Mational Engineering Laboratory are reported by Chase (1972), and Armstrong and others (1975). Walker (1964) showed that the subsurface anology of the north central cart of the eastern Snake River Plain constate of at least 3,317 ft (1,011 m) of interbedded Quaternary and Wengene basaltic lawn flows and beds of silt and silty clay. Walker (1964) showed evidence that the sedimentary portion of the stratigraphic section is primarily alluvial in origin, consisting of stream and lake

In well 7-24 the basaltic lava flows are similar in texture and closes 1 composition throughout the upper 2,000 ft (610 m). There are over 34 separate basaltic lava flows to the drill core from well 2-2A. They are generally fine- to medium-grained, porphyritic, diktytaxitic aliving basalts. Phenocrysts include plagioclase and olivine in a groundwase of plagiculase, olivine, pyroxene, magnetite, ilmenite, and elass. Below about 1,900 ft (579 m), the basalts are hydrothermally altered and mineralized. This alteration and mineralization includes: filling of weatcles by calcite, zeolites, and serpentine; deposition of those same minerals along fractures; and serpentinization of the basalt, specially near some of the fractures. Many of the fractures show serpentialized slickensides. The clay-rich sediments in the lower 1,000 ft (300 m) of the well are also altered; evidence includes an overall presents color to the clay-rich sediments, and the presence of altered grains of biorite and basalt.

At least 8 thin, rhyolitic air-fall ash beds are exposed in the delli core. The glass shards in these layers appear petrographically to to meffected by the alteration. A crystal-poor, rhyolitic, Althophysial, densely welded ash-flow tuff, consisting of two flow units. pecure at a depth of 2,521 ft (768 m) to 2,558 ft (780 m). The lower the unit consists of a black basal vitrophyre resting on a few feet of vitronhantle alr-fall ash. The vitrophyre grades up into a densely walded, lithophysal, devitrified ash-flow tuff. The upper flow unit consists of about 2 ft (0.5 m) of devitrified densely welded ash-flow tuff. This man-flow tuff is similar in texture and mineral content to ash- Inv tuffs exposed at the southern end of the Lemhi Range, as described by Poss (1961), Chase (1972), and Malde and others (1971). Complements at a distance on tooks and sediments from this well will Investigate their are, geochemistry, alteration, paleontology, magnetic promettes, and possible correlations.

RIVER

RANGE

ENGINEERING

Base from Robertson, and others, 1974.

IDAHO

Big Southern Burre

MAP

NATIONAL

LABORATORY

Table 1 .-- Geophysical log internation concerning drill hole 2-2A, located in the NW 1/4, sec. 15, T. 5 N., R. 31 L., Butte County, Idaho.

Marine San	ng		Logged Interval	
No.	Type	Date Logged	Feet	Meters
1	Temperature1/	9-22-78	0-2640	0-805
2	Temperature1/	9-24-78	2640-2990	805-911
3	Temperatur 2/	10-01-78	221-2614	67.5-797
ė.	Gamma1/	9-22-78	0-2640	0-805

Logged by N. L. McCullough Co., Box 5185 W. Yellowstone Hwy., Casper, Wyoming 82601.

Logged by Charles A. Brott and David D. Blackwell, Institute for the Study of Earth and Man, Geothermal Laboratory, 253 Heroy Juilding, Southern Methodist University, Dallas, Texas 75275.

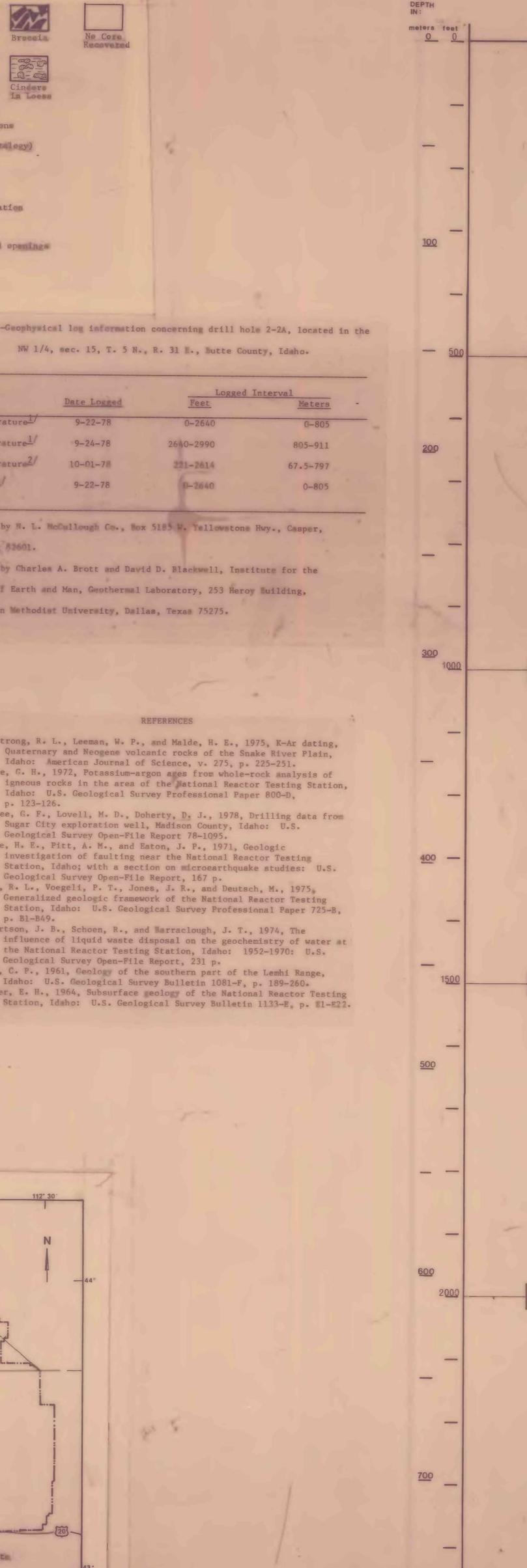
Armstrong, R. L., Leeman, W. P., and Malde, H. E., 1975, K-Ar dating, Quaternary and Neorene volcanic rocks of the Snake River Plain, Idaho: American Journal of Science, v. 275, p. 225-251. Chase, G. H., 1972, Potassium-argon ares from whole-rock analysis of igneous rocks in the area of the National Reactor Testing Station, Idaho: U.S. Geological Survey Professional Paper 800-D,

p. 123-126. Embree, G. F., Lovell, M. D., Doherty, D. J., 1978, Drilling data from Sugar City exploration well, Madison County, Idaho: U.S. Geological Survey Open-File Report 78-1095.

Malde, H. E., Pitt, A. M., and Eaton, J. P., 1971, Geologic investigation of faulting near the National Reactor Testing Station, Idaho; with a section on microearthquake studies: U.S. Geological Survey Open-File Report, 167 p. Nace, R. L., Voegeli, P. T., Jones, J. R., and Deutsch, M., 1975 Generalized geologic framework of the National Reactor Testing

p. B1-B49. Robertson, J. B., Schoen, R., and Barraclough, J. T., 1974, The influence of liquid waste disposal on the geochemistry of water at the National Reactor Testing Station, Idaho: 1952-1970: U.S.

Geological Survey Open-File Report, 231 p. Ross, C. P., 1961, Geolow of the southern part of the Lemhi Range, Idaho: U.S. Geological Survey Bulletin 1081-F, p. 189-260. Walker, E. H., 1964, Subsurface reology of the National Reactor Testing Station, Idaho: U.S. Geological Survey Bulletin 1133-E. p. E1-E22.



LITHOLOGIC DESCRIPTIONS

the rock volume, respectively

SCALE LITHOLOGIC

-

400

600

700

200

300

1900

2100

700 2300

800

2900

600

LOG

Basalt -- Reddish-brown to medium-gray, fine-grained, diktytaxitic, dense to vestcular, porphyritic offuine basalt. Phenocrysts include lath-shaped, subsers! to subhedral crystals of plagiorlass as much as I on long, and vellow-green, anhedral to subhedral crystals of olivine about 1 mm long. The plagic last phenocrysts make up 40 percent to 70 percent, and the olivine phenocrysts make up 7 percent to 10

Sand--Brown to reddish-brown, angular to subangular, medium- grained arkosic sand. The mineralogy is dominated by quartz and feldspar; granules (<1 mm) of dark-brown to black fine- grained basalt are

Silty clay and sand -- Interbedded gray to gravish-brown silty clay, and brown to plive-gray, well-surted, fine- to medium-grained, subangular to subrounded, arkosic, quartz sand. Silty clay is the dominant lithology and commonly contains small sand langes which measure 5 cm in length and 2 cm in height Basalt -- Dark - gray to brown, and black, fine-grained, diktytaxitic, dense to vesicular, porphyritic alluing basalt. Vesicles range in size from 1 mm to 4 cm and constitute 2 percent to 30 percent of the rock volume. Olivine occurs as small (<1.5 m), anhedral to subhedral, green vitreous phenocrysts, which make up 3 percent to 5 percent of the rock volume. Phenocrysts of small (<1 mm) gray lath-shaped grystals of plagioclase constitute as much as 10 percent of the rock volume

ilty clay--Gray to brownish-gray, fine-grained silty clay, with 5 percent of the sample volume being subrounded quartz sand grains. Small (5 mm) fragments of black fine-grained basalt are common in the lower portion of the bed. The silty clay is of alluvial origin

Basa't--Medium- to dark-gray, fine-grained, diktytaxitic, dense to vesicular, porphyritic olivine basalt. The vericles range in size from 1 mm to 5 mm and constitute as much as 5 percent of the rock volume. Lath-shaped phenocrysts of plagiculase, 1-2 mm, constitute from 1 percent to 5 percent of the rock volume. Olivine occurs as small (<2 mm), reddish-brown, vitreous subhedral phenocrysts

Silty clay--Light-brown, plane-bedded, very fine grained silty clay. Calcite-filled burrows are common in the middle part of this unit. The sediment is alluvial in origin Sand--Light-brown to reddish-brown, fine- to medium-grained, subangular, iron-stained, micaceous, alluvial

quartz sand. Pebbles of vesicular basalt are common in the lower 2 ft of this unit asalt--Brown to brownish-gray, fine-grained, diktytaxitic, vesicular, porphyritic olivine basalt. The vesicles are irregular in shape, average 5 mm, and constitute approximately 10 percent of the rock volume. Phenocrysts include small (<2 mm) sobedral plagioclase laths, and small (<2 mm) anhedral to subhedral crystals of clivine. Planioclase and clivine phenocrysts make up 10 percent and 5 percent of

Silty clay--Brown to brownish-gray, very fine grained silty clay. Small (1 mm) fragments of black to brown fine-grained basalt constitute as much as 15 percent of this unit Basalt--Medium-gray to dark-gray, and brownish-gray, fine-grained, diktytaxitic, dense to vesicular, porphyritic olivine basalt. The vesicles are round to irregular in shape, range from 2 mm to 3 cm, and constitute as much as 20 percent of the rock volume. Phenocrysts include small (<3 mm) lates and plates of transparent vitreous plagioclase and small (<2 mm), green to greenish-brown, subhedral to anhedral

crystals of olivine. Olivine phenocrysts make up approximately 5 percent of the rock volume. A thin (<1 ft) clay bed, separating lava flows, occurs at a depth of 429 ft (131 m). Small reddish-brown basalt cinders are common in the light-brown clay unit Sand--Reddish-brown to grayish-orange, fine-grained, subrounded to subangular, quarta-rich alluvial sand lasalt--Reddiah-brown, medium-gray to purplish-gray, and creenish-black, fine-grained, dense to vestcular, diktytaxitic, perphyritic olivine basalt. The vesicles are round to irregular in shape, range in size

from 0.5 mm to nearly 3 cm, and constitute from 1 to 15 percent of the rock volume. Phenocrysta include euhedral to subhedral planicclase laths (average size 1.0 mm), and small (22 mm), reddish-brown to yellow-brown, vitreous, subhedral to anhedral crystals of clivine. The plagicclase and ollvine phenocrysts make up 10 percent, and 3-4 percent of the rock volume, respectively Silty clay-Orange to orange-brown, fine-grained silty clay with 10 percent of the volume being fine-

grained, subangular, arkosic, alluvial quartz sand dasalt -- Medium-aray, and brown to brownish-gray, fine-grained, dilitytasitie, danse to vesicular, porphyritic olivine basalt. The vesicles are round (1-5 mm), and range to approximately 1 percent to 30 percent of the rock volume. Phenocrysts of anhedral to subhedral, grand and reddish-brown, vitrous olivine crystals constitute 5 percent of the rock volume and average 3 mm in size

Silty clay-Light-brown silty clay. Pebbles of vesicular fine-grained baselt occupy approximately 10 percent of the sediment volume Masalt--Medium- to dark-gray, brownish-gray, and reddish-brown, fine-grained, dense to vesicular, diktytaxitic, porphyritic olivine basalt. The vesicles are small (3-6 mm), mostly round, and occupy 1 to 10 percent of the rock volume. Olivine phenocrysts (1-2 mm) occur as reddish-brown to green,

vitreous, anhedral to subhedral crystals occupying 2-4 percent of the rock volume Sand and silty clay--Red-brown, medium- to fine-grained, quarte-rich, iron-stained alluvial sand grading downward into brown to light-brown silty clay. A few pebbles (up to 2 cm) of vesicular basalt occur in the sand and silty clay

Basalt--Dark- to medium-ray, and reddish-brown, fine-grained, dense to vesicular, diktytexitic, prophyritic olivine basalt. The vesicles are round to irregular in shape, range in size from 1 mm to

1.5 cm, and occupy 2 to 20 percent of the rock volume. Small phenocrysts of placioclass and oliving are present throughout this set of basalt flows. Planioclase phenocrysts occur as subsdral laths (1-2 mm), and make up 2-4 percent of the rock volume. Oliving phenocrysts constitute about 3-5 percent of the rock volume and occur as anhedral to subhedral (<2 mm), reddish-brown vitreous crystals

Silty clay--Reddish-brown to brown to vellowish-brown, sandy, silty clay. Small clasts (<1 mm) include fine-grained basalt and angular pink microcline. The sand is fine grained, subrounded, and quartz rich and makes up <10 percent of this unit

Basalt -- Medium- to dark-grav, reddish-brown, and brownish-grav, tine-grained, diktytaxitic, deuse to vesicular, ilmenite-rich olivine basalt. The vesicles are mostly irregular in shape, and range from 0.5-2 mm in diameter. Ilmenite occurs as small (<1.0 mm), elongate, euhedral blades and makes up approximately 3-5 percent of the rock volume. Olivine occurs as reddish-brown, vitreous, subhedral crystals (<.7 mm) constituting approximately 1-3 percent of the rock volume. Thin sediment beds separate several individual flows, at the following deaths; 913 ft (278 m), 918 ft (280 m), 934 ft (285 m), 937-943 ft (286-287 m), and 945 ft (298 m). The sediment layers are chiefly medium to dark gray and brownish gray silty clays and sandy silts, probably of eolian origin

Silty clay and sand--Light-brown, and greenish-gray, bedded, poorly-sorted, sandy, milty clay interbedded with brownish-gray, fine- to medium-grained, poorly sorted, subangular to subrounded, quarta-rich alluvial sand. Basalt grains (average size 1-2 mm) are common throughout. Small lenses of sand within the silty clay are common from depths of 1,085-1,100 ft (331-335 m). Fossils, including smalls and clams, occur at 1,007-1,010 ft (307-308 m). A thin, 6-in. (15-cm), fine-grained, rhyulitic, vitroclastic, air-fall ash layer occurs at 1,063 ft (324 m)

asalt--Dark- to medium-gray, brownish-gray, greenish-black, and reddish-brown, fine-grained, diktytaxitic, dense to vesicular olivine basalt. Vesicles are mostly small (5-7 mm), round to irregular, and make up 1-55 percent of the rock volume. Olivine is present as 1-mm annearal to subhedral grains making up about 1-3 percent of the rock volume

Sandy wilt--Light-brown to orange-brown sandy wilt (looss) containing classy, vesicular to dense baselt Basalt -- Medium- to dark-gray, fine-prained, dense to vesicular basalt. Phenogrysta include green allvine and sparse plagioclase

Silty clay--Greenish-gray, well-sorted, plane-bedded silty clay Basalt--Medium- to light-gray, fine-grained, diktytaxitic, porphyritic olivine basalt. Olivine occurs on small, subhedral, yellow-brown, vitreous phenocrysts, consisting up to 3 percent of the rock volume Silty clay and sand--Gray to brownish-ray to yellowish-gray, poorly-sorted, alluvial, sandy and silty clay; interbedded with thin beds of quartz-rich, fine-grained, poorly sorted, magnetite-hearing and

Silty clay--Crayish-brown, slightly sandy to silty clay Basalt--Dark- to medium-gray, fine-grained, dense, vesicular to amvedaloidal, oliving basalt. The vesicles and amygdules are sparse, and are lined and filled with euhedral calcite rhombs, and zeolites. Olivine occurs as small (<1 mm) sphedral to subhedral crystals, which constitute up to 1

percent of the rock volume Silty clay-Gray to brown, poorly-sorted eclian, sandy to silty clay with 10 percent in-prained subrounded quartz sand Basalt -- Gray to greenish-gray, fine-grained, dense, any daloidal basalt. The anyodules are mostly filled

with calcite and zeolites ilty clay--Gray to greenish-gray, plane-hedded, alluvial silty clay Silty clay, clay, and sand--Creen to greenish-gray alluvial silty clay, interhedded with thin layers of

green clay, and brown, fine- to medium-grained, quartz-rich and Basalt--Cray to dark-ray, and greenish-black, fine-rained, dense, porphyritic, altered basalt.

Phenocrysts of small (<2 mm) lath-shaped crystals of plastoclase make up 5 percent of the rock volume Silty clay -- Light-brown to greenish-gray, poorly sorted, tuffaceous silty clay of alluvial origin

Basalt--Bark-green to greenish-black, fine-grained, altered, dense, amgudaloidal basalt. Several fractures exhibit slickensides and some appear to be serpentinized. Alteration of the hazalt is often

Clay--Greenish-gray highly altered(?) clay

Basalt--Creenish-black, dark-green, greenish-brown, and reddish-brown, fine-grained, fractured, amgydaloidal, highly altered basalt

cand-Greenish-tray, fine-grained, silty, poorly sorted, quarte-rich and

Resalt -- Creenish - ray to dark-green, and dark-brown to greenish-black, fine-grained, highly altered. fractured, appydaloidal olivine basalt. The olivine is altered to iddingsite and occurs as small crystals (<1 mm) that make up 3-4 percent of the rock volume. A thin reddish-brown altered scorlageone zone occurs between 2,231 ft (680 m) and 2,237 ft (682 m)

Silty clay--(ray to brown silty clay of eolian origin

Massit -- Purplish-gray, ereenish-gray, and dark-gray to greenish-black, fine-grained, ungicular, amgydaloidal, highly altered olivine basalt. The olivine is altered to iddingaite and occupies approximately 5 percent of the rock volume. The amgridules show up to 3 stages of mineralization including zeolites, calcite, and serpentine

thyolitic welded ash-flow tuff -- Gray to brownish-gray, purplish-gray, black, and pink, fine-grained, crystal-poor, vitric to devitrified, lithophysel to spherolitic, eutaxitic, densly welded ash-flow tuff. The ash-flow contains two flow units. The lower flow unit is approximately 30 ft (10 m) thick and consists of a densly-welded basal vitrophyre which grades upwards into a spherolitic, lithophysal, devitrified, densly welded ash-flow tuff. The lower flow unit rests on approximately 2 ft (0.6 m) of coarse vitric air-fall ash. The upper flow unit is approximately 5 ft (1.6 m) thick, and consists of pisk, devitrified, crystal-poor, entaxitic, densly welded ash-flow tuff

Silty clay-Light- to moderate-brown, tuffaceous, plane-bedded, silty clay. Small pebbles of dark-gray altered fine-grained basalt are common in the lower 3 ft (1 m) of the bed

Basalt--Brownish-gray and dark-gray, altered, dense to vesicular, amygdaloidal, porphytitic ulivine basalt. Vesicles range from approximately 1 mm to approximately 5 mm in size and make up 30 percent of the rock volume. A few vesicles are filled with 2 or 1 generations of mineralization including reolites, calcite, and serpentine. Phenocrysts of enhedrel plagioclase (cl mm) and altered olivine amount to less than 2 percent of the rock volume. Many fractures in the basalt show serpentinged

Silty clay and sand-Reddish-brown, brown to light-brown, and gray, plane-bedded silty clay of alluvial origin; interbedded with gray to light-brown, subangular to subrounded, sorted, quartz-rich alluvial Basalt--Cray to dark-gray, and greenish-black, altered, vesicular to anyedaloidal, fractured olivine

basalt. Vesicles are round and average 3-5 mm in diameter, making up 5-15 percent of the rock volume.

Amyedules are present at a depth of about 2,703 ft (824 m). Several of the fractures show sorrential and Silty clay--Light-brown to greenish-gray silty clay, 5-10 percent of which is fine-grained quarte-rich

Basalt--Plack to dark-gray, highly altered amyadaloidel basalt Basalt--Brown, black, and tan, brecciated, altered besalt Silty clay and sand -- Interhedded greenish-gray sandy and silty clay of alluvial origin; and green to gray, medium- to fine-grained, angular to subangular, arkosic, poorly sorted alluvial and. Three thin, vitroclastic, rhyolitic air-fall ash beds occur within this sediment hed at the following depths:

Rhyolitic air-fall ash--Cray to bluish-gray, fine-grained, Vitroclastic, rhyolitic air-fall ash Silty clay--Greenish-gray to gray, plane-bedded, tuffaceous silty clay. Pyritized roots are present at a depth of 2,947 ft (898 m) wolltic air-fall ash--Gray to bluish-gray, reworked, fine-grained, vitroclastic, rhyolitic air-fall ash i ty clay--Creenish-gray, plane-bedded, tuffaceous, alluvial silty clay and-- rown to greenish-gray, coarse- to medium-grained, subangular to subrounded, poorly sorted, quarte-

2,802 ft (854 m), 2,857 ft (871 m) and 2,919 ft (890 m)

rich alluvial sand

